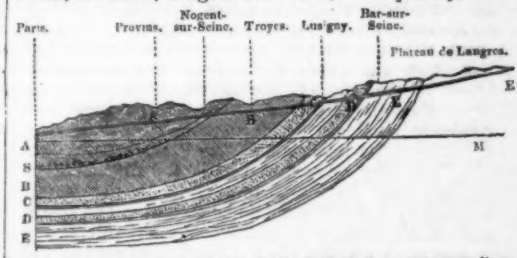
## THE ARTESIAN WELL AT GRENELLE, PARIS.

Artesian Wells are so called from the probability that they were first constructed in Artois, although, from the authority of several ancient writers, they appear to have been in use in the earliest ages. The Artesian well at Grenelle, of which the above woodcut is a representation, has lately been completed, after eight years of constant labour and repeated difficulties. The south-western portion of Paris was but very poorly supplied with water, and at Grenelle, a suburb immediately adjoining the city, this deficiency was so seriously felt that it became an object of the greatest importance to find means of remedying the evil. M. Mulot, an experienced geologist, being consulted as to the practicability of constructing a well on the Artesian principle, stated that the perforation would necessarily be of extraordinary depth, owing to the nature of the district. We extract from the 'Magasin Pittoresque' the following geological description of the basin of Paris:—"Two conditions, as it is well known, are requisite for the formation of an Artesian well: first, the existence of a pervious stratum, such as gravel, placed between two impervious strata, such as clay; secondly, the percolation of the water through the pervious stratum from a point higher than that to which it is required to rise. The basin of Paris is in the form of a hollow plate (B, B) formed by a stratum of chalk. In this basin have been successively deposited the tertiary strata, in the centre of which Paris is situated. On a circular space bounded by the towns of Laon, Mantes, Blois, Sancerre, Nogent-sur-Seine, and Epernay, these




[A, A, Tertiary strata above the chalk; B, B, chalk or cretaceous limestone; C, C, D, D, green-sand and clay; E, E, oolite and Jura limestone, A, E, general slope of the country from Langres to Paris; A, M, level of the sea.]

strata appear at the surface, and conceals the chalk, but on the other side of the towns we have mentioned, the edge of the basin being passed, the chalk is found generally on the surface. If we look at the order in which the tertiary strata occur, we shall then comprehend the obstacles M. Mulot had to overcome, and the probability of the ultimate success of his undertaking. Leaving unnoticed the surrounding hills, we will examine the nature of the soil which composes the

Plain of Grenelle. On the surface it is formed of gravel, pebbles, and fragments of rock, which have been deposited by the waters at some period anterior to any historical record. Below this surface M. Mulot knew, by geological inductions and previous experience, that at Grenelle marl and clay would be found in place of the limestone which in general forms the stratum immediately beneath. M. Mulot was aware he must bore about four hundred and forty yards in depth, before he should meet with the sources (S), which flow in the gravel below the limestone and supply the wells of St. Ouen, St. Denis, and Stains. Beneath the marl and clay, the boring-rods had to perforate pure gravel, plastic clay, and finally chalk, which forms the bottom of the basin in which the tertiary strata have been deposited. No calculations or geological knowledge could determine the thickness of this stratum of chalk, which from its powers of resistance might present a nearly insurmountable obstacle. The experience obtained in boring the wells of Elbeuf, Rouen, and Tours was in this respect but a very imperfect guide. But supposing this obstacle to be overcome, was he sure of finding a supply of water below this mass of chalk? In the first place, the strata (C, D) below the chalk possessed, as we shall see, all the necessary conditions for producing Artesian springs, namely, successive layers of clay and gravel, or pervious and impervious beds. M. Mulot confidently relied upon his former experience of the borings of the wells at Rouen, Elbeuf, and Tours, where abundant supplies of water had been found below the chalk between similar strata of clay and gravel.

But one other condition is requisite to effect the rising of the water in an Artesian well, viz. that the point of infiltration should be higher than the orifice above which the water is to rise. This also was the case at Grenelle. In fact, M. Arago had shown that the water of the spring in question would necessarily rise to the surface, because, in the well at Elbeuf, which is nearly nine yards above the level of the sea, the water rises from twenty-seven to twenty-nine yards above the surface of the earth, and consequently from thirty-six to thirty-eight yards above the level of the ocean. Now, as the orifice at Grenelle is only thirty-four yards above this same level, it follows that if the same spring were met with, the water must rise above the surface of the earth at Grenelle.

The necessary works were now commenced with boring-rods about nine yards long, attached to each other, and which could be raised or lowered by mechanical means; and an ingenious method was adopted for giving them a circular motion. The diameter of the bore-hole was about six inches. The instrument attached to the end of the lowest boring-rod was changed according to the different strata which were successively reached, the form adapted for passing through the softer materials of the surface being unsuitable to boring through the chalk and flint, a hollow tube being used for the former, while the latter was penetrated by a chisel-shaped instrument. The size of the rods diminished in proportion to the depth, and as the subterranean water was not reached so soon as was expected, it became requisite five several times to enlarge the diameter of the bore, to admit of the work being successfully continued. Accidents occurred also, which tried the utmost patience of the projectors. In May, 1837, when the boring had extended to a depth of four hundred and eighteen yards, the hollow tube, with nearly ninety yards of the boring-rods attached to it, broke, and fell to the bottom of the hole, and it was necessary to extract the broken parts before any further progress could be made. The difficulty of accomplishing this may be conceived when it is stated that the different fragments were not withdrawn until after the lapse of fifteen months. A description of the ingenious mode by which this was effected would be too technical for our work. Again, in April, 1840, in passing through the chalk, the chisel attached to the boring-rod became detached, and before it could be recovered several months were spent in excavating round it. A similar occurrence created an obstacle which impeded the work for three months, but instead of being withdrawn, the detached part was driven literally into the stratum, which happened to be gravel. At length, in February, 1841, after eight years' labour, the rods suddenly descended several yards: they had pierced the vault of the subterranean waters of which M. Mulot had been so long in search. In the course of a few hours the water rose to the surface, and discharged itself at the rate of 600,000 gallons per hour. The depth attained was six hundred and two yards, or about three times the height of St. Paul's. The pipe by which the water reaches the surface has recently been carried to a height nearly on a level with the source of supply. The pipe, as it rises from the ground and the scaffolding which supports it, are shown in the cut. At present the water flows into a circular iron reservoir at the top of the scaffold, and it is thence conveyed by another pipe to the ground. The water is of good quality, and well adapted for culinary and domestic purposes. There is no fear of the supply proving deficient, as it is derived from the infiltration of a surface of country nearly two hundred miles in diameter. The Artesian wells of Elbeuf, Tours, and Rouen, which were formed many years ago, flow in an invariable volume. The ancient Artesian well at Lillers, in the Pas de Calais, has for above seven centuries furnished a constant and equable supply. When the source of supply is less extensive, these wells may be subject to variations, but the probability of this may generally be foreseen by the geologist and the engineer.

The opportunity of ascertaining the temperature of the earth at great depths was not neglected during the progress of the works at Grenelle. Thermometers placed at a depth of thirty yards in the wells of the Paris Observatory invariably stand at 53° Fahrenheit. In the well at Grenelle the thermometer was 74° at a depth of four hundred and forty-two yards, and at five hundred and fifty yards it stood at 79°. The depth attained being six hundred and two yards, the temperature of the water which rose to the surface was 81°, corroborating previous calculations on the subject. Now that the patient labour of so many years is brought to a close, our neighbours regret that it was not necessary to go to a depth of about one thousand yards for a supply, as the water would then have been at a temperature of 104°, and immediately applicable to bathing establishments and other places in which warm water is required.

## CHAUCER'S PORTRAIT GALLERY

### THE SHIPMAN.

"A SHIPMAN was there woned* far by west;
For ought I wote he was of Dartemouth.
He rode upon a rouncie† as he couthe‡,
All in a gown of falding§ to the knee;
A dagger hanging by a lace had he
About his neck, under his arm adown.
The hotte summer had made his hue all brown,
And certainly he was a good fellów.
Full many a draught of wine he hadde draw
From Bourdeaux ward, while that the chapmen sleep;
Of nicé conscience took he no keep.

* Lived.
† A common hackney horse.
‡ That is to say, as well as he was able.
§ A kind of coarse cloth.

If that he fought, and had the higher hand,
By water he sent them home to every land.
But of his craft to reckon well his tides,
His streames and his strandes him besides,
His herberow*, his moon, and his lodemanage†,
There was none such from Hull unto Carthâge.
Hardy he was and wise, I undertake;
With many a tempest had his beard been shake.
He knew well all the havens as they were
From Gothland to the Cape de Finisterre,
And every creek in Britain and in Spain:
His barge ycleped was the Magdalen."

Commerce about and a little prior to the period of Chaucer made so great an advance, that the Shipman was doubtless an important, and, considering the dangers of his avocation and the variety of adventures he was constantly meeting with, a very interesting character. The magnet only became known in Europe towards the end of the twelfth century, and did not, it is supposed, get into familiar use before the middle of the thirteenth. Chaucer, indeed, and his Scottish contemporary Barbour, are the first British writers who notice it. From the description we perceive some of the channels in which the commerce of the fourteenth century flowed. English vessels passed to and fro between our country and France, Spain, and the places along the coast from "Gothland to Finisterre;" and among the ports Hull and Bourdeaux are particularly mentioned. A peculiarity of the mercantile navy at this period was its being frequently employed in warlike expeditions; and to that circumstance we owe the preservation of many particulars as to its extent, &c. When Henry III., in 1253, ordered all the vessels in England to be seized and employed against the rebel barons in Gascony, their number, according to Matthew Paris, was above a thousand, of which three hundred were large ships. When Edward III. was besieging Calais, he had with him 710 vessels belonging to English ports, with crews to the number of 14,151 persons. It may be interesting to see the relative proportion of the men and ships furnished by the different places in England, as it may be taken as a tolerably exact criterion of their relative maritime importance. London sent 25 ships with 662 men; Margate, 15 with 160; Sandwich, 22 with 504; Dover, 16 with 336; Winchelsea, 21 with 596; Weymouth, 20 with 264; Newcastle, 17 with 414; Hull, 16 with 466; Grimsby, 11 with 171; Exmouth, 10 with 193; Dartmouth, 31 with 757; Plymouth, 26 with 603; Looe, 20 with 325; Fowey, 47 with 170; Bristol, 24 with 608; Shoreham, 20 with 329; Southampton, 21 with 572; Lyme, 16 with 482; Yarmouth, 43 with 1095; Gosport, 13 with 403; Harwich, 14 with 283; Ipswich, 12 with 239; and Boston, 17 with 361. In the whole there are scarcely twenty men to a ship, so that the vessels generally must have been small. Later in the same century, and during Chaucer's life-time, 1360, Edward issued a similar order to that before mentioned, for arresting all the vessels in his dominions; the largest were now directed to carry forty mariners, forty armed men, and sixty archers. Such a ship must have been of very respectable dimensions for its more peaceful and legitimate avocations. Of the kind of articles which formed the staple commodities of commerce during the period of the poet, we have a sufficiently exact account in the Records of the Exchequer for the year 1354, the oldest document we possess of the kind. From them it appears that the exports of that year were—31,651½ sacks of wool, at 6*l.* per sack; 3036 cwt. of wool, at 40*s.* per cwt.; 65 woolfels, at a total value of 21*s.* 8*d.*; hides to the value of 89*l.* 5*s.*; 4774½ pieces of cloth, at 40*s.* each (of the same kind as the Shipman's "falding" perhaps); and 8061½ pieces of worsted stuff, at 16*s.* 8*d.* each: total value of the exports, 212,338*l.* 5*s.*, paying customs to the amount of 81,846*l.* 12*s.* 2*d.* From these figures it appears that wool constituted about thirteen-fourteenths of the entire exports of England. The imports consisted of 1831 pieces of fine cloth, at 6*l.* each; 397¾ cwt. of wax, at 40*s.* per cwt.; 1829½ tuns of wine, at 40*s.* per tun; and linens, mercery, grocery, &c. to the value of 22,943*l.* 6*s.* 10*d.*: making a total value of 38,383*l.* 16*s.* 10*d.* The wines here referred to, and which appear to have formed the chief commodity with which our shipman was concerned, were those of France, Spain, Greece, and Syria.

For ought he knows, says the poet, the shipman was of Dartmouth; a glance at the comparative importance of Dartmouth among the chief maritime places of England, as shown above, will explain this remark. Dartmouth contributed a more important total of ships and men than any other place in England, with the exception of Yarmouth. It was, no doubt, looked on through the country as peculiarly the seaman's home. Shipmen and Dartmouth were ideas probably as familiar to our countrymen in Chaucer's time as sailors and Portsmouth now. This position Dartmouth owed, no doubt, to the convenience of its harbour, which can still accommodate 500 ships. As to Bourdeaux, where the Shipman has been accustomed to leave such a very equivocal reputation behind him, we may observe that it then belonged to the English, and that wine is still the staple export of the city. The touches of character by which Chaucer so happily marks all his creations are not wanting here:—the Shipman's riding as well as he could; no doubt succeeding as well as your true seaman is generally accustomed to succeed on horseback;—the brown hue, and the beard that has been shaken by many a tempest,—all show how accurately Chaucer drew from the life, how he must ever have described that alone which he saw.

* Harbourage.

† Even so late as the reign of George III. we find this word in use in the sense in which Chaucer applies it, namely, pilotage. See the stat. 3 Geo. I., c. 13. From the same idea, that of *leading*, the north star is called the *lode*-star, and the magnet the *lode*stone.

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*Life of the Husbandman in Hindostan.*—The husbandman rises with the earliest dawn, washes, and says a prayer, then sets out with his cattle to his distant field. After an hour or two he eats some remnants of his yesterday's fare for breakfast, and goes on with his labour till noon, when his wife brings out his hot dinner; he eats it by a brook or under a tree, talks and sleeps till two o'clock, while his cattle also feed and repose. From two till sunset he labours again; then drives his cattle home, feeds them, bathes, eats some supper, smokes, and spends the rest of the evening in amusement with his wife and children or his neighbours. The women fetch water, grind the corn, cook, and do the household work, besides spinning and such occupations.—*Elphinstone's Hist. of India.*

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Those who, in confidence of superior capacities or attainments, disregard the common maxims of life, should remember that nothing can atone for the want of prudence; that negligence and irregularity long continued will make knowledge useless, wit ridiculous, and genius contemptible.—*Johnson.*

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It is truly a most Christian exercise to extract a sentiment of piety from the works and the appearances of nature. It has the authority of the sacred writers upon its side, and even our Saviour himself gives it the weight and the solemnity of his example. "Behold the lilies of the field; they toil not, neither do they spin, yet your heavenly Father careth for them." He expatiates on a single flower, and draws from it the delightful argument of confidence in God. He gives us to see that taste may be combined with piety, and that the same heart may be occupied with all that is serious in the contemplations of religion, and be at the same time alive to the charms and the loveliness of nature.—*Dr. Chalmers.*

[Remains of Stoke Manor-House.]

## RAILWAY RAMBLES.

### STOKE.

AT a short distance from the churchyard the stranger may see some ancient chimneys (of those beautiful forms which give our old architecture a character something different from the square lumps of brick of modern times) rising out of the masses of trees which form a picturesque background to the church. These chimneys belong to what remains of the fine old manor-house of Stoke—a place full of the most interesting associations. The history of the place is thus told by Lysons, in his 'Buckinghamshire:'—

"Amicia de Stoke brought the manor of this place in marriage to Robert Poges, who was chosen one of the knights of the shire in the year 1300; his granddaughter and heir, Egidia, married Sir John Molins, knight-baronet and treasurer of the chamber to king Edward III. In 1331 he had the royal licence for fortifying and embattling his mansion at Stoke; and in 1346 he procured a charter that Stoke and Ditton, where also he had a seat, should be exempt from the authority of the King's Marshal. From Sir John Molins this manor descended by female heirs to the families of Hungerford and Hastings. Henry Hastings, earl of Huntingdon, rebuilt the manor-house in the reign of Queen Elizabeth. The estate was soon afterwards seized by the crown for a debt. King James the First, about the year 1621, granted the manor in fee to Lord Chief Justice Coke, who appears to have held it many years before as lessee under the crown. In 1601, being then Attorney-General, he entertained Queen Elizabeth very sumptuously at this place, and presented her Majesty with jewels to the value of 1000*l.* or 1200*l.* In 1625, this celebrated lawyer, having quitted his high station, and being out of favour with the court, was obliged, much against his will, to serve the office of sheriff for the county; and it was thought by his friends a great degradation, that he, who had filled one of the highest situations on the bench, should attend on the judges at the assizes. Sir John Villiers, elder brother of the Duke of Buckingham, married Sir Edward Coke's only daughter, and this manor (then held by lease) having been settled on him at the time of his marriage, he was, in 1619, created a peer by the title of Baron Villiers of Stoke-Poges, and Viscount Purbeck. Lord Purbeck succeeded to this estate after the death of Sir Edward Coke, which happened in 1634, at his seat at Stoke-Poges. The house, it appears, was settled on his lady, who was relict of Sir William Hatton.

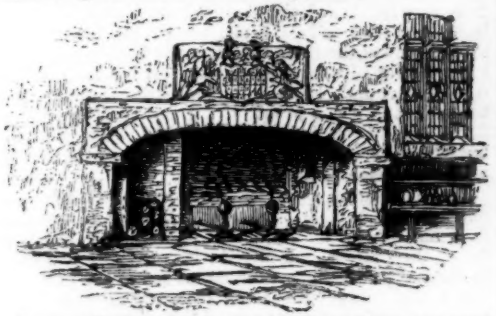
"In 1647 Stoke House was for a short time the residence of the unfortunate King Charles, when he was a prisoner in the power of the army. Not long after the death of Lord Purbeck, which happened in 1656, the manor of Stoke was sold by his heirs to John Gayer, Esq., elder brother of Sir Robert Gayer, K.B., who afterwards possessed it. It was purchased of the Gayers, about the year 1720, by Edward Halsay, Esq., one of the representatives of the town of Buckingham, whose daughter Anne married Lord Cobham. Stoke House and the manor were sold by her heirs to William Penn, Esq., chief proprietor of Pennsylvania."

When Gray resided at Stoke, the old Manor-house was occupied by Lady Cobham; and the poem of the 'Long Story' was founded upon a visit which two ladies residing at the Manor-house paid the poet at his mother's cottage. The opening of the poem is very spirited; and it gives a fine poetical notion of what the old mansion was:—

> "In Britain's isle, no matter where,
> An ancient pile of building stands:
> The Huntingdons and Hattons there
> Employ'd the power of fairy hands
>
> To raise the ceiling's fretted height,
> Each panel in achievements clothing,
> Rich windows that exclude the light,
> And passages that lead to nothing.
>
> Full oft within the spacious walls,
> When he had fifty winters o'er him,
> My grave Lord-Keeper led the brawls;
> The seals and maces danced before him.
>
> His bushy beard, and shoe-strings green,
> His high-crown'd hat, and satin doublet,
> Mov'd the stout heart of England's Queen,
> Though Pope and Spaniard could not trouble it."

With the exception of one wing, the Manor-house was pulled down in 1789; and a modern house, with portico and cupola, was erected at some distance, by Wyatt. We believe that if the old house had endured

to our own time, such a destruction would not have taken place. The new mansion has a more commanding site; and is one of those pretty things which the age of George III. produced—having no characteristic of nation or age—bad copies of exotic originals. But it gives us nothing that can compensate for the sweeping away of the fabric which told the story of one of the most striking periods of our annals, and of more than one of the really great men of a great age. It is gone. We have an old kitchen left, capacious enough for the hospitality of an attorney-general who had a queen for his guest; and the wide fire-place is still remaining with its heraldic sculptures.



In a small room on the second floor there are some rude paintings, also heraldic, on the plastered walls, with the initials E. R.; on another side are some quaint inscriptions, amongst which we deciphered—

"FEARE THE LORDE.
OBEY THE PRINCE.
LOVE THINE ENMIS.
BEWARE OF PRIDE.
SPEKE THE TRUETH.
BEWARE OF MALLIS."

The scenery immediately surrounding the old Manor-house is exceedingly picturesque.

About half a mile from the church is the house in which Gray resided. It is called Westend Cottage; and is now a very commodious villa, with pleasing-grounds and ornamental water. The house, however, has been much enlarged and modernized. It appears to us that Gray meant to describe it in the following passage of a letter to his friend Palgrave:—

"I do not know how to make you amends, having neither rock, ruin, or precipice near me to send you; they do not grow in the South: but only say the word, if you would have a compact neat box of red brick with sash-windows, or a grotto made of flints and shell-work, or a walnut-tree with three mole-hills under it, stuck with honeysuckles round a basin of gold fishes,

and you shall be satisfied; they shall come by the Edinburgh coach."

The walnut-tree still remains; and so does the summer-house or grotto.

## THE RAIN-GAUGE, OR PLUVIOMETER.

There are but few of us who would not be glad to know whether and when "it is going to rain," but we are not yet in a condition to lay down rules in the matter. It is not known what is the total quantity of rain which falls, nor how far it differs in different years at the same place; neither is it certain that all the causes which tend to produce rain are known to us. Much, very much, has yet to be done before these points can be determined; and the only mode of determining them is by careful observations on the phenomena of weather, by the aid of well-constructed instruments. One of the most obvious of these instruments, so far as rain is concerned, is the *rain-gauge* or pluviometer, concerning which we shall here offer a few explanatory observations.

The rain-gauge, however it may be formed, is an instrument or vessel for catching the rain as it falls, with a view of determining, at the end of any given period, the quantity of rain which has fallen within that period. This quantity is not measured by the gallon or other analogous measures, nor by weight, but by depth in inches; that is, if a large flat-bottomed vessel were exposed openly to the rain, and the rain-water could be prevented from evaporating, how many inches depth of water would there be in it at the end of a given period? It is evident that this depth would be the same whether the vessel was a yard square or a foot square, provided the shape and position of the two were alike. In practice, however, it is necessary to guard against the effect of evaporation, and also to provide the means of conveniently measuring the quantity of rain which has fallen. These objects have given rise to the various forms of rain-gauge.

Most rain-gauges consist of a funnel whose stem descends into a bottle or other close vessel beneath. In an instrument invented by Mr. Pickering during the last century, the rain was received in a tin funnel only one inch square, and thence descended into a graduated glass tube half an inch in diameter; by observing the height at which the water stood in the tube at the end of any given time, and comparing the diameter of the tube with the dimensions of the funnel, the number of inches of rain fallen was ascertained. In the old rain-gauge at the Royal Society's apartments, the rain was received in a conical funnel twelve inches in diameter, strengthened at the top by a brass ring twelve inches in diameter; the sides of the funnel and the inner lip of the brass ring were inclined to the horizon at an angle of 65°, and the outer lip at an angle of 50°, with a view both of preventing the rain which fell within the funnel from being splashed out, and of preventing the introduction of that which fell on the outer lip.

Dr. Heberden used a tin funnel, the stem of which consisted of a very long tube, which passed into a bottle through a cork, to which it was exactly fitted; the tube went down very near to the bottom of the bottle, and therefore the rain which fell into it would soon rise above the lower end of the tube, so that the water was nowhere open to the air, except for the small space of the area of the tube: scarcely any evaporation could take place from such an instrument. Dr. Gordon employed a rain-gauge consisting of a copper funnel five inches in diameter at the top, and inserted at the bottom into a tube of the same metal. This tube was thirty inches in length, one and a half in diameter, and furnished with a stop-cock at the lower end. It was examined every morning at ten o'clock, and if any rain had fallen during the twenty-four hours, it was

measured by letting it off through the stop-cock into a glass tube half an inch in diameter, with an attached scale of inches and tenths. By this means the rain that fell in a circular area five inches in diameter was collected in an area half an inch in diameter (one-tenth as much); and as the superficial area of the one was a hundred times that of the other, inches and tenths of water in the tube corresponded to hundredths and thousandths of an inch of rain on the surface of the ground. To prevent waste by evaporation, the communication between the funnel and the copper tube was made very narrow; and the upper edge or rim of the funnel was bent so as to prevent the splashing of the water.

Dr. Trail describes the following form of rain-gauge:—It consists of a cylindrical copper vessel, rather less than four inches in diameter; upon the upper part of which a funnel of the same metal, with an upright brim, exactly one foot in diameter, is fitted. A hollow vessel of metal, or a piece of cork, serves as a float, to support a rod of box-wood graduated in tenths of an inch. The water which falls into the funnel finds its way into the cylinder, and raises the float. The quantity is read off the rod at a stay placed across the funnel; and from the relative proportion of the cylinder and the funnel, each one-tenth of an inch is equivalent to one-hundredth of an inch of water entering the mouth of the funnel.

A rain-gauge recommended by Mr. Howard is the following:—The funnel is fitted on the neck of a glass bottle, by means of an exterior tube which is soldered to the funnel, and prevents the entrance of water into the vessel except through the mouth of the funnel. The quantity of rain is ascertained by a graduated glass measure, the divisions of which correspond to one-hundredths of an inch falling on the mouth of the funnel.

Professor J. Phillips, having in his researches on rain, conducted at York under the auspices of the British Association, been led to notice the importance of determining the direction in which rain falls, as well as the quantity, constructed a very ingenious rain-gauge with this object in view. It consists of a compound gauge, having five equal receiving funnels and tubes: one with a vertical tube and horizontal aperture; the other four with tubes recurved, so as to present the openings of the funnels in four vertical planes, directed to four quarters of the horizon. Each tube has a cock at the lower end for drawing off the water into a graduated tube. Now, it is obvious from such an arrangement, that the funnels will receive different quantities of rain during any one shower. If the rain descend perpendicularly, none will fall into any of the lateral funnels (the rims of which are vertical); if it descend obliquely from east to west, consequent on an east wind, some will fall in the east funnel, but none in the other three lateral funnels; if it come from a direction a little southward of east, a small quantity will fall in the south funnel, and a larger in the east; if the rain veer about in different directions during a shower, it is just possible that all the lateral funnels may receive portions of it. The rain which falls in the funnels being carefully measured after each shower, the observer is able immediately to determine the direction and inclination of the rain.

So long as one rain-gauge is employed at any one station, the results which it affords are of but partial benefit; but when different gauges are placed near each other, but at different heights, some very remarkable phenomena are observed. It is found that more rain falls at the earth's surface than at several feet above the surface. This has been decisively shown by Mr. Phillips's rain-gauge experiments at York; but the fact was observed seventy years ago by Dr. Heberden and Mr. Daines Barrington. A comparison having been made between the quantity of rain which fell in two places in London, about a mile distant from one another, it was found that the rain in one of them constantly exceeded that in the other, not only every month, but almost every time that rain fell. As the gauges were exactly alike, and were observed in a similar manner, attempts were made to ascertain the cause of the difference. One of the gauges was fixed so high as to rise above all the neighbouring chimneys; the other was considerably below them; and there appeared reason to believe that the difference in the quantity of rain in these two places was owing to this difference of height. To test this opinion, three rain-gauges were regularly observed for twelve months, from July, 1766, to July, 1767; one being placed on the square part of the roof of Westminster Abbey, another upon the top of a dwelling-house, and the third not far from the ground. Each rain-gauge was examined once a month, and it was found, at the end of the year, that while twenty-two inches of rain had fallen into the lowest gauge, only eighteen had fallen into the middle one, and twelve in the uppermost.

Mr. Barrington, a year or two afterwards, made some experiments to show that this difference of quantity does not depend on the actual difference of level between the stations, considered with reference to a truly horizontal plane, but on the difference of the height at which the instruments stood from the ground. Two facts were adduced in support of this. Two rain-gauges were placed, the one upon Mount Rennig in Wales, and the other in the plain below, at about half a mile's distance; the perpendicular height of the mountain being about thirteen hundred feet, and the gauges being placed respectively at equal heights above the surface of the ground at the two stations, it was found that the quantity of rain received in the two gauges was very nearly equal. The second fact was, that of the two gauges experimented on at the two houses in London, that one into which the greater quantity of rain had fallen, although placed at a lower part of the house to which it was attached, was in reality fifteen feet above the level of the other, which, in another part of London, was placed above the top of the house, and into which the lesser quantity always fell.

Repeated observations of this kind have been since made, but a good deal of doubt has existed as to the correctness of the registers kept. Recently, however, Mr. Phillips has observed these phenomena at York with very great care. In the year 1832 he placed three rain-gauges at different elevations at York: one on the top of the Minster, at a height of two hundred and forty-two feet from the level of the river; one on the top of the Yorkshire Museum, at a height of seventy-three feet; and the other in a garden, at the height of twenty-nine feet. Each gauge consisted of a cubical box of tin, measuring ten inches each side, open at top, and receiving, at an inch below its edge, a funnel sloping to a small hole in the centre. The water which entered the funnel was poured into a cylindrical glass vessel graduated to cubic inches and fifths of cubic inches. Hence one inch depth of rain in the gauge was measured by one hundred inches of the graduated vessel; and one-thousandth of an inch of rain was easily read off. With these instruments Mr. Phillips found that one year's rain in the three gauges was about sixteen, twenty, and twenty-four inches respectively, the lowest gauge receiving the largest quantity. The next year gave (in round numbers) fifteen, twenty, and twenty-six inches; and subsequent years have given proportions more or less analogous to these.

The circumstance is therefore no longer doubted that rain *does* fall more plentifully at the level of the ground than at a greater elevation, and many theories have been started to explain it. Mr. Phillips thinks the

whole difference in the quantity of rain, at different heights above the surface of the neighbouring ground, is caused by the continual augmentation of each drop of rain from the commencement to the end of its descent, as it traverses successively the humid strata of air at a temperature so much lower than that of the surrounding medium, as to cause the deposition of its moisture on its surface. The arguments which have been adduced in confirmation of or in opposition to this opinion we shall not here detail, as the subject is yet in its infancy.

In some 'Instructions for making and registering Meteorological Observations,' circulated by the South African Literary and Philosophical Institution, established at the Cape of Good Hope, are the following remarks relating to the rain-gauge:—"The rain-gauge is an instrument of such extremely easy construction, that any person who lives near a tinman can procure one. In arid climates, it must, however, be remembered that it will often need examination and cleansing, owing to long intervals of disuse, in which insects and dust may lodge. It will often happen too that the slight rain of one day, if left unregistered, may be entirely lost by evaporation in the next; nay, that slight and transient showers may never enter it, being evaporated from it as they fall. The effect of copious dew, too, must be separated from that of rain, so that the mere registry of the contents of the gauge is not of itself a sufficient indication whether rain has fallen in the night or not. However, there are usually good reasons for decision on this point from other indications. Attention to the amount of dew is very necessary, not only because the meteorological questions involved are of a high degree of interest generally, but because in arid climates the dews are of almost as much importance to the maintenance of vegetation as the rain. In stating the quantity of rain daily received in the gauge, the height of the receiver above the soil should be mentioned, experience having shown that the quantities of rain which actually fall in a given area on the ground, and at a very moderate height above it, often differ materially. In some localities and circumstances the rain-drops receive accession from the air as they descend, in others they undergo partial evaporation. The former is generally the case in cool moist climates."

## INUNDATIONS IN HOLLAND IN 1825.

[Concluded from page 438.]

It would have been happy for the Dutch if this had been the whole or even the greater part of the damage done to their country at the beginning of February, 1825, but this was only a small portion of the calamity. The same high tide, the same violent tempest of wind and rain, and the same irresistible pressure of the water against the dykes, extended round the whole interior of the basin of the Zuider Zee. In many places its sea-bulwarks were driven down; in others the waters rose above them and poured over them with a full flood into the devoted country below for five or six hours without obstacle or interruption. The consequence was that a large portion of the extensive provinces of Overyssel, Friesland, and Groningen was deluged in a single night, and filled as brimful to the level of the sea as if no barrier had existed to check its fury.

In East Friesland and Overyssel especially, the inundation was terrific, and the damage immense. Out of the thirty-two lordships of which the former consists, only five escaped the flood. The rest were all partly or entirely overflowed, and more than one hundred thousand acres of their most fertile land converted into a salt-water lake. The flood in this quarter rose four feet above the dykes, and poured in upon the country below in a continuous stream. It was impossible to resist, and difficult by the most rapid flight to escape its fury. Men, cattle, and every living thing fell a sacrifice to its rage. In many of the villages and farm-steadings not a house was left standing, nor was a head of cattle saved. The number of men who perished in the water, or were crushed to death by their falling houses, amounted to about one hundred. In one lordship only the number of black cattle drowned amounted to more than a thousand. In some places the villages and churches were raised a little above the level of the fields and meadows. Thither the peasants, therefore, ran for safety. In the church of the village of Wolvega, for instance, four hundred of these wretched beings took refuge from the surrounding flood, without being able to carry with them a single article of food or rag of clothing, and remained benumbed with cold or perishing with hunger till the arrival of means of relief.

In other cases, four or five hundred of them were found crowded together in the market-places, among falling houses, exposed to the inclemency of a wintry sky, and every sort of physical destruction. In one case, where a multitude had retreated to the shelter of a church, its roof was set on fire by lightning. The miserable victims of the inundation thus saw their lives contested by the two fiercest elements of nature, and were threatened to be burned in the midst of the deluge. These sacred edifices, though often raised on higher ground, and made of more durable materials, than the cottage of the peasant, or the houses of the village, were sometimes, like them, unable to withstand the weight of the flood, and, falling down, again exposed the wretched refugees to the inclemency of the storm. Sometimes, when the houses left standing were sufficient to receive the shivering outcasts of those which had fallen, the churches were converted into cow-houses or stables for the remnant of the rescued cattle; for such deep and overpowering calamities confound all conventional distinctions of places and things, and substitute an irresistible and unreasoning necessity for sentiment and feeling. The devouring element, which had swallowed up the dwellings of the living, and even disinterred the coffins of the dead, left neither time, power, nor inclination to attend to the sacredness of an open asylum. The churches, where found standing, were converted indiscriminately into hospitals, stables, or storehouses. To what other purpose could they now be destined? The dreadful catastrophe happened near the close of the week. In a few hours the Sunday approached, and the village bell would have called the people to the house of prayer; but it had previously sounded the tocsin of alarm, and hastened them to other scenes. Instead of indulging in peaceful worship, they were now called to fly from their homes, or to struggle for their lives—to hear the bellowing of their drowning cattle, or the crash of their falling houses—to escape in crowded boats over their flooded farms, or to attempt a safe standing on the labouring dykes, against which they saw their household furniture, their agricultural implements, their winter stores, their all, dashed like the foam of a surf. In such a scene of suffering, in such an immeasurable desolation, "waste and wild," the strong walls of the churches, instead of being profaned, were doubly consecrated by offering a place of refuge. Many of the houseless outcasts of the inundation continued to occupy this kind of retreat till the middle of March, supplied with clothes and food by the charity of their less suffering neighbours.

As the district called *Heetslellengwerf* suffered more than most of the other districts of this province, we may just state the amount of the damage. It lost 836

horned cattle above two years old, and 549 below that age, or in all 1385; 18 horses, 265 sheep, and 54 goats; 15,177 roods of peats, and more than a million of pieces of timber. Besides this, 166 farm-steadings and hamlets were injured, damaged, or entirely swept away. In two small hamlets 400 cattle were lost. In two other districts upwards of a thousand of the previously wealthy inhabitants remained towards the middle of March, deprived of all their property, destitute of everything, and dependent for their daily support on the charity of others. The breaches made in the dykes, the carrying off of farm produce, the loss in provisions, fuel, and furniture,the destruction of trees —whose roots the salt water had withered—and the ruin of more than twenty square miles of excellent land, for a year or two to come, presented an overwhelming mass of damage in this province, of which it would be difficult to calculate the amount.

But the devastation of Friesland was small compared with that of Overyssel, though the extent of the inundation was greater. In the latter province, according to official reports, more than two hundred and fifty men were known to be drowned, and others had disappeared who were supposed to be lost; ninety thousand acres of the best land were deluged; fifteen hundred houses were entirely swept away, and double the number greatly damaged; fourteen thousand large cattle destroyed, besides sheep and smaller animals; and four thousand families, previously in wealthy or comfortable circumstances, entirely ruined, and left to depend on public charity or national compensation. The loss in manufactories, magazines, tanneries, saltworks, windmills, stores, trees, dykes, and other establishments, was almost incalculable.

In the higher province of Gelderland the inundation was likewise frightful and destructive, though not so extensive nor ruinous as in the two bordering states. It drowned about thirty persons, and carried off more than one thousand cattle. It advanced so far as to threaten even the dykes of the province of Utrecht. Groningen, East Friesland, and Emden likewise suffered severely; all the country at the mouth of the Ems, and for several miles into the interior, being laid under water both from the sea and the river.

The province of Zealand, which includes Walcheren and the other islands at the mouths of the Scheldt and the Meuse, sustained great damage in the breaches made in its dykes and bulwarks, and in the destruction of inanimate property, though only one life was lost, and no extensive ruin occasioned. The streets of Middleburg and Flushing were laid under water, and considerable injury was done to the houses. The activity of the burgomaster and the zealous co-operation of the inhabitants of the latter place, prevented more extensive calamities, by filling up the breaches as soon as they were made. The whole island was in most imminent danger. The islands of Schowen, Tholen, and South Beveland had likewise to lament the violence of the storm, and the pressure of the waters upon their bulwarks. But the most extensive inundation which took place on the western side of the United Provinces was that which proceeded from the overflowing of the Bieschbosch near Dort, itself an inland sea, proceeding from a similar convulsion, which is said, in 1425, to have occasioned the destruction of seventy-two villages, and the death of one hundred thousand inhabitants. The deluge of February, 1825, covered about six thousand acres of fertile land, and threatened with destruction the city and island of Dort. The water rose ten feet in the streets of the suburbs. Considerable damage was done both here and on the Meuse at Rotterdam.

All along the coast of the German Ocean from Ostend, the ramparts of which were partially damaged and seriously endangered, to the Helder, in North Holland, and the islands which act like breakwaters at the entrance of the Zuider Zee, the tempest extended, and the sandbanks and dykes were injured. At the Helder, the immense blocks of granite brought from Norway to compose a durable sea-wall were unable to withstand the violence of the waters, and were scattered about like pebbles. Most of the cluster of islands which we have mentioned (we mean the Texel, Flieland, Terspelling, and Ameland) were inundated and greatly damaged.

Since the year 1170 there have been nine great inundations of different provinces of the Netherlands, more or less destructive, namely, those of 1170, 1404, 1421, 1470, 1531, 1532, 1570, 1592, and 1633; but none of them, with the exception perhaps of that which created the great lake near Dort, in 1421, committed such dreadful havoc on the defences of the country and the property of the people as that of February, 1825. Only a wealthy and industrious people could repair the public injury, or enable the sufferers to support their individual losses

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*Chinese Idea of Death.*—A Chinese, convicted of a cruel murder, had been sentenced to transportation for life. His friends, who sought to procure a mitigation of his punishment, solicited my supposed influence as an Englishman with the Governor on their behalf. I urged the aggravated nature of the offence as a reason why I could not even conscientiously ask such a thing, if I were sure of success; and suggested that it ought to be a matter of thankfulness he was not hanged. He immediately replied, that he considered this a much severer punishment than death; for in that case his parents, who were living, might have performed his funeral rites and the usual offices at the tomb, of which he was now deprived, while they would also be totally cut off from all intercourse with their son after death as well as in life.—*China, by Professor Kidd.*

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*Language of England.*—At this extraordinary period, when England was a foreign kingdom, the English people found some solitary friends—and these were the rustic monk and the itinerant minstrel, for they were Saxons, but subjects too mean and remote for the gripe of the Norman, occupied in rooting out their lords to plant his own for ever in the Saxon soil. The monks, who lived rusticated in their scattered monasteries, sojourners in the midst of their conquered land, often felt their Saxon blood tingle in their veins. Not only did the filial love of their country deepen their sympathies, but a more personal indignation rankled in their secret bosoms, at the foreign intruders, French or Italian, —the tyrannical bishop and the voluptuous abbot. There were indeed monks, and some have been our chroniclers, base-born, humiliated, and living in fear, who in their leiger-books, when they alluded to their new masters, called them "the conquerors," noticed the year when some "conquerors" came in, and recorded what the "conquerors" had enacted. All these "conquerors" designated the foreigners, who were the heads of their houses. But there were other truer Saxons. Inspired equally by their public and their private feeling, these were the first who, throwing aside both Latin and French, addressed the people in the only language intelligible to them. The patriotic monks decided that the people should be reminded that they were Saxons, and they continued their history in their own language. . . The true language of the people lingered on their lips, and it seemed to bestow a shadowy independence to a population in bondage. The remoter the locality, the more obdurate was the Saxon; and these indwellers were latterly distinguished as "Uplandish" by the inhabitants of cities. For about two centuries "the Uplandish" held no social connection; separated not only by distance, but by their isolated dialects and peculiar customs, these natives of the soil shrank into themselves, intermarrying and dying on the same spot; they were hardly aware that they were without a country. —*D'Israeli's Amenities of Literature.*